

of any one of them (*i.e.* two units) will double (or halve) the rate at which any particular substance, the action of which on the cell it is desired to study, will be absorbed. The method is a neat one, but it possesses obvious drawbacks, unless the separate action upon the cell of its constituents in the different strengths employed is fully known. The formulæ employed present an unfamiliar appearance, as the factors are all added together, and the inclusion amongst them of time- and heat-factors, on the basis of units composed of ten minutes and 5° C. respectively seems to assume unusual simplicity in the reactions involved.

By means of this method, however, depending largely on the entrance of the stain to the nucleus, many surprising results were obtained. The addition, for example, of various alkaloids, putrefactive products, &c., led the author to formulate far-reaching conclusions as to the causes underlying cell division, with the result that he believes himself to be justified in announcing the discovery of the main causes that bring about cell division, and induce cell proliferation. The causal agents in question are, of course, chemical, and probably most people who have paid any attention to the matter would agree with Mr. Ross that the fundamental causes of mitosis (nuclear division) are assuredly of a chemical nature. He thinks he has identified certain of these bodies, and this would constitute a most important addition to science if his views as to their action on the living cell should turn out to be as well founded as he imagines them to be.

It is, however, difficult to avoid scepticism on this very point, namely, as to whether the evidence on which the conclusions are drawn is really cogent, and whether the latter are themselves fully warranted.

The author might himself have contributed towards the solution of these crucial difficulties had he seen fit, in addition to the picturesque presentation of his results, to have subjected the foundations on which they rest to a full and wary criticism. For it is clear enough from the account actually given that the cells, even as they were being examined in the jelly, were morituri. It is stated, over and over again, that under the conditions of the experiments it was not easy to keep them alive for more than ten minutes. It is not, after all, very surprising to learn that all sorts of movements and distortions followed on the application of drugs like atropin, but it is at least uncommon to find that a mitosis can be completely carried through in three minutes. Numerous examples of alleged "mitosis" are described, and photographs are adduced in support of the descriptions. But the photographs themselves are singularly unconvincing, and suggest fragmentation or breaking up of the cell as a whole rather than anything one would expect to see in an actual cell- or nuclear-division. We fail to find any critical guard against misinterpretation of phenomena that might be due to osmotic differences or to the poisonous action of reagents employed.

Nor is one reassured by the account of mitosis (*i.e.* nuclear-division) as referred to in the book. The treatment of the whole subject is suggestive of the enthu-

siastic amateur who is simply unable, owing to temperament or lack of training, critically to check and examine his own work. Of course, we do not mean positively to assert that such is really Mr. Ross's position, but anyone who puts forward statements on mitosis such as appear on pp. 148 and 149, or again on p. 166, without producing the strongest and most convincing proofs, must not complain if in other directions his views fail to command unreserved acceptance. We are not at all surprised to learn that when Mr. Ross attempted to convince his friend of the soundness of his conclusions by demonstrating to them his preparations they all with one consent, as he himself avers, "began to make excuse."

It may be readily admitted that the book contains much that is interesting and valuable by way of suggestion, but we do not regard the conclusions of its author on cell-division and cell-proliferation as sufficiently well founded.

J. B. F.

THE EVOLUTION OF LUNAR DETAIL.
Vergleichende Mond- und Erdkunde. By Prof. S. Günther. Pp. xi+193. (Braunschweig: F. Vieweg und Sohn, 1911.) Price 5 marks.

THE resemblance which exists between the surface of the globe and that of the moon, as shown in the irregularities of level and the general character of the superficial formations, has long attracted attention, and much ingenious speculation has been exhibited in tracing a connection and seeking the cause. Fanciful theories exist without number, but men of the highest eminence have occupied themselves with the same theme, being led to it by the fascinating problem of the "Plurality of Worlds." This is the attraction that has induced Prof. Günther to study the subject, or, perhaps it would be more correct to say, to sift and examine what others have written about it. His book is a marvel of research and a triumph of industry. He seems to have examined all that has been written, whether in fact or fiction, bearing on the relations of earth and moon. Mr. H. G. Wells and Jules Verne represent one school of thought; Procter and Flammarion another; the highest authorities, as Darwin, Loewy, and Puiseux, form a third. Every page bristles with notes, and is encumbered by the author's commentaries on those notes. This arrangement perhaps shows greater power of collection than of assimilation. Much of the matter, if worth preserving, could have been incorporated in the text and made the book easier to read.

But however wide the outlook, whether in time or in nationality, problems connected with the physical constitution of inaccessible bodies are likely to remain unsettled, and the discussion prove barren of result. The history of this speculative inquiry is profoundly interesting, but from a philosophical and not an astronomical point of view. We are indebted to the author for the skill with which he has marshalled his facts and the enormous amount of information he has collected, but the moon seems little likely to contribute any fresh facts of importance to the main issue, since the probability in favour of similarity of structure and of evolutionary history is so great. By whatever pro-

cess we suppose the genesis of the moon to have been accomplished, it would be difficult to imagine a body so near the earth not possessing the same external characteristics and passing through similar geological changes. There is some evidence to show that the actual materials that once formed part of the globe were transferred to our satellite, and this probability is strengthened by the agreement between the density of the moon and that of the superficial rocks on the earth. Indeed, as the author reminds us, there are not wanting those who can point to the exact spot where the catastrophe occurred that in times past tore from the earth the eightieth part of its mass.

The main result of the author's examination is to show the general uniformity of the conviction possessed by all students of the lunar surface that the earth and moon have passed through approximately identical processes of evolution. Prof. Günther reproduces the speculations of ancient Greek philosophers and continues the theme to modern times. Kepler's "Traum von Monde" and the observations of Galileo form connecting links, with the results derived from lunar cartography. In this newer research we start from Hevel and Cassini onwards to the exact methods of Meyer, Lohrmann, Schmidt, and Neville Neison. We are reminded of the artistic work of Nasmyth and Carpenter, of Klein, and of Weinck, and justice is done to their penetrating insight and the ingenuity with which they have pursued their researches. One does not realise how engrossing this subject has proved, how keen has been the attention and the hold it has had upon so many ardent workers, until the whole history is methodically exposed.

Another chapter is devoted to the results of photographic research, in which the pioneer work of De la Rue, Rutherford, and Draper is reviewed, and the history traced down to the admirable series of pictures issued from the Paris Observatory by MM. Loewy and Puiseux. The last four or five chapters are really the kernel of the whole. Herein are considered the formation of lunar craters, the origin of the bright streaks, the debated question of changes of the surface, sufficient in amount to be observed telescopically. The tectonic and orogenic structures here come under review, also, but without much approval, the views of Mr. G. K. Gilbert as to the possibility of the fall of meteors influencing or explaining the external features of our satellite.

SUBSTITUTION IN BENZENE.

Die direkte Einführung von Substituenten in den Benzolkern. Ein Beitrag zur Lösung des Substitutionsproblems in aromatischen Verbindungen.
By Prof. A. F. Holleman. Pp. vi+516. (Leipzig: Veit and Co., 1910.) Price 20 marks.

IT is well known that the empiric rules of substitution, which have been evolved from the study of the aromatic compounds, may enable a chemist to predict roughly the result of such a process; it is equally well known that not one of these rules is free from exceptions. The absence of any rational theory underlying the process or the lack of novelty in the methods employed may have deterred chemists in

recent years from following up what was formerly regarded as one of the most attractive lines of inquiry; but it is quite certain that very little in the way of systematic study, especially of a quantitative character, has been done in this field of research. Yet the process of substitution possesses not merely a theoretical significance; it has a very considerable technical value. The formation of halogen, nitro and sulphonate derivatives of aromatic compounds are among the most familiar technical operations of the colour-maker.

Though the subject has undoubtedly suffered from neglect, nevertheless a few serious students of the process are to be found. Prof. Holleman and his pupils have for many years devoted themselves to the task of systematising the scattered facts and adding new knowledge by a careful qualitative and quantitative study of these reactions. The volume before us contains not only an account of these inquiries and a critical review of methods and results, but forms at the same time a complete book of reference to all the published observations referring to benzene derivatives containing up to three substituents. It is obviously a work of immense labour, but should be invaluable to those engaged in this fundamental branch of organic chemistry. It may possibly also serve to direct more attention to a topic of so much interest. It is impossible in a limited space to give more than an outline indicating the scope of the book.

The first three chapters contain an account of substitution methods, the quantitative estimation of the products by chemical and physical means (many of which have been devised in the author's laboratory), and the nature of the di-derivatives formed.

Chapter iv. contains a compendium of results and a critical review of the rules and theories of orientation. Some of the apparent inconsistencies and contradictions in the ordinary rules may be realised from such facts as the following:—The nitration of a halogen derivative of benzene containing an atom of fluorine, chlorine, bromine, or iodine follows the ortho-para rule, yet the amount of ortho compound under similar conditions varies from 12 to 37 per cent. in the four cases. In the nitration of benzonitrile, nitrobenzene, benzoic acid and its esters, all of which are supposed to follow the meta rule, the first gives exclusively a meta compound, whereas the three latter yield an amount of ortho compound varying from 6, in the case of nitrobenzene, to 28 per cent. in that of ethyl benzoate. Whilst aniline and dimethylaniline under certain conditions give meta or meta and para compounds as chief products, dimethylaniline oxide and nitrous acid give mainly ortho and para derivatives. But perhaps the most striking case is that of acetanilide, which, when nitrated in presence of sulphuric acid, gives 80 per cent. of para, but when acted on by nitrogen pentoxide in a solution of acetic anhydride, forms almost exclusively the ortho derivative.

The empirical rules which have been drawn up at different times by Hübner, Nöting, Armstrong, Crum-Brown, and Gibson, and Vorländer, are carefully considered and rejected in turn as inconsistent with the facts, whilst the theories of Armstrong,